

## What are Space Shuttle Tiles Made From?

### Standard Statement:

3.4.7 A- Describe concepts about the structure and properties of matter.

### Content Objectives:

*Students will be able to:*

1. Determine which material would be better suited for use as space shuttle tiles.
2. Determine if metal or sand is a better conductor of heat.

### Process Objectives:

*Students will be able to:*

1. Discuss the advantages and disadvantages of using various materials for the construction of tiles on the outside covering of the space shuttles.
2. Data collection and analysis.

### Assessment Strategies:

1. Data collection of temperature readings under varying conditions.
2. Analysis of data collection in a comprehensive essay based on the results of the experiment and information collected on the NASA website.

### Procedures:

1. Discuss with students the extreme temperature variation encountered in space due to the lack of atmosphere. Also discuss how the friction caused by the atmosphere when the shuttle returns to earth causes a need for a highly isolating material to be used to cover the shuttle.
2. Have students assemble into lab groups and gather the necessary materials.

### Suggested Level:

Intermediate/Secondary

### Standard Category:

3.4—Physical Science, Chemistry and Physics

### Materials:

Two, 250 ml beakers.  
Aluminum metal pieces  
Coarse sand  
Two thermometers  
Heat lamps

### Instructional Strategies:

Experimentation  
Cooperative learning  
Research  
Essay writing  
Interpreting data

### Related Concepts:

Understanding the space environment

## What are space shuttle tiles made from?

### Thought question to begin:

Which is a better conductor of heat, metals or nonmetals? \_\_\_\_\_

### Investigation:

To decide which material would be better suited for the exterior of the space shuttle, conduct the following investigation.

1. Place approximately 350ml of sand in a 400ml beaker. In a second 400ml beaker, place the same volume of aluminum shot.
2. Insert a thermometer into each beaker so the bulb of the thermometer is in the middle of the sample. Record the initial temperature of each sample.
3. Place each sample under a heat lamp and record the temperature change in each every 5 minutes for a total of 30 minutes in the data table.
4. Place all materials back in their proper locations and clear the lab area.

*Data Table:*

Time (minutes)	Temperature of sand (°C)	Temperature of Al (°C)
0		
5		
10		
15		
20		
25		
30		

**Questions to ponder:**

1. Why is aluminum a better conductor of heat than sand?
2. The tiles that cover the outside of the space shuttle are made from very porous glass, which has been whipped with air so it acts as an insulator to protect the crew inside the shuttle. What is an insulator?
3. Are metals or nonmetals better insulators?
4. What element is the main component of sand?
5. What do sand and glass have in common?

**Follow up Activity:**

1. You have been placed in charge of the NASA division that will design the space shuttle tiles. In an essay, discuss the results of your experiment and your recommendations for the design and materials for the tiles.
2. Conduct the same experiment using ice to cool the samples over time. Are the results similar?

## Lab Report

Name \_\_\_\_\_ Date \_\_\_\_\_ Course/Class \_\_\_\_\_

Task/Assignment \_\_\_\_\_

	Title/ Introduction	Background Research	Question/ Problem/ Hypothesis	Procedures	Data & Results	Conclusions	Language Usage
<b>Weights</b> →							
<b>Expert 4</b>	The title states clearly both the independent dependent variables and the results of the experiment. The title of the report is written in a clear declarative statement. The lead-in information is concise and develops a clear understanding of the report to follow. A concise abstract of the lab is provided and does not exceed 250 words. <input type="checkbox"/>	Relevant literature and prior observations are cited which provide much insight into the phenomena to be included in the report. <input type="checkbox"/>	The question or problem that the lab was designed to answer is well articulated. The hypothesis is eloquently stated in the "If-and-then" format. It predicts the influence of the independent variable on the dependent variable. <input type="checkbox"/>	The procedures for controlling and measuring the dependent variable are well defined and clear. A detailed, logical step-by-step set of procedures that were used for conducting the lab is listed. Safety concerns are listed among the procedures. <input type="checkbox"/>	Data tables and graphs are expertly and neatly completed and totally accurate. Patterns or trends in data are noted. Data analysis is thorough. <input type="checkbox"/>	A response to both the question and hypothesis is clearly and completely provided and is consistent with the data. Limitations and extrapolations of the data are cited. Questions for further study are developed. Unresolved questions and problems are listed. <input type="checkbox"/>	Language is used correctly and purposefully. All words are spelled correctly. The report is neat, legible, and presentable. <input type="checkbox"/>
<b>Proficient 3</b>	The title states both the independent dependent variables and the results of the experiment. The title of the report is written in a clear declarative statement. The lead-in information is concise and develops a clear understanding of the report to follow. <input type="checkbox"/>	Relevant literature and prior observations are cited which provide insight into the phenomena to be included in the report. <input type="checkbox"/>	The question or problem that the lab was designed to answer is listed. The hypothesis is stated in the "If-and-then" format. It predicts the influence of the independent variable on the dependent variable. <input type="checkbox"/>	The procedures for controlling and measuring the dependent variable are defined and clear. A detailed, logical step-by-step set of procedures that were used for conducting the lab is listed. Safety concerns are missing form the procedures. <input type="checkbox"/>	Data tables and graphs neatly completed and totally accurate. Patterns or trends in data are noted. Data analysis is thorough. <input type="checkbox"/>	A response to both the question and hypothesis is provided. Some limitations and extrapolations of the data are cited. <input type="checkbox"/>	Language is used correctly and purposefully. Some words are misspelled, but with little or no effect upon the final product. The report is neat, legible, and presentable. <input type="checkbox"/>

## Lab Report (continued)

	<b>Title/ Introduction</b>	<b>Background Research</b>	<b>Question/ Problem/ Hypothesis</b>	<b>Procedures</b>	<b>Data &amp; Results</b>	<b>Conclusions</b>	<b>Language Usage</b>
<b>Emergent 2</b>	<p>The title is stated in a rambling, non-concise fashion. There is an attempt within the title to state both the independent dependent variables and the results of the experiment. The title of the report is written in a declarative statement. The lead-in information lacks conciseness and clarity.</p> <div> <input type="checkbox"/> <input type="checkbox"/> </div>	<p>Literature and prior observations are cited, but provide little insight into the phenomena to be included in the report.</p> <div> <input type="checkbox"/> <input type="checkbox"/> </div>	<p>The question or problem that the lab was designed to answer is ill defined. The hypothesis is stated, but not in the "If-and-then" format.</p> <div> <input type="checkbox"/> <input type="checkbox"/> </div>	<p>Some of the steps are understandable; most are confusing and lack detail.</p> <div> <input type="checkbox"/> <input type="checkbox"/> </div>	<p>Data tables and graphs are completed, but lack accuracy. Patterns or trends within the data are difficult to discern. Data analysis lacks thoroughness.</p> <div> <input type="checkbox"/> <input type="checkbox"/> </div>	<p>Presents an illogical explanation for findings.</p> <div> <input type="checkbox"/> <input type="checkbox"/> </div>	<p>For the most part, language is used correctly. However, many words are misspelled, impacting upon the final product. The report borders on being sloppy, illegible, and not presentable.</p> <div> <input type="checkbox"/> <input type="checkbox"/> </div>
<b>Novice 1</b>	<p>The title is stated in a rambling, non-concise fashion. There is no attempt within the title to state the independent and dependent variables and the results of the experiment. The title of the report is written in a declarative statement. The lead-in information provides little or no information that leads into the report.</p> <div> <input type="checkbox"/> <input type="checkbox"/> </div>	<p>Literature and prior observations are not cited.</p> <div> <input type="checkbox"/> <input type="checkbox"/> </div>	<p>The question or problem that the lab was designed to answer is not defined. There is no hypothesis.</p> <div> <input type="checkbox"/> <input type="checkbox"/> </div>	<p>Not sequential, most steps are missing or are confusing.</p> <div> <input type="checkbox"/> <input type="checkbox"/> </div>	<p>Data tables and/or graphs are missing information and are inaccurate. Consequently, patterns or trends within the data are not discernable. Little attempt is made at data analysis.</p> <div> <input type="checkbox"/> <input type="checkbox"/> </div>	<p>Presents an illogical explanation for findings and does not address the question that guided the lab.</p> <div> <input type="checkbox"/> <input type="checkbox"/> </div>	<p>Language is used incorrectly and without purpose. Many words are misspelled, impacting significantly upon the final product. The report is definitely sloppy, illegible, and not presentable.</p> <div> <input type="checkbox"/> <input type="checkbox"/> </div>

# Writing to Inform in Science (Extended Constructed Response)

Name \_\_\_\_\_ Date \_\_\_\_\_ Course/Class \_\_\_\_\_

Task/Assignment \_\_\_\_\_

Weights →	Development	Organization	Audience	Language
<b>Expert 4</b>	<u>Development:</u> The writer provides accurate, specific, and purposeful scientific facts and concepts that are extended and expanded to fully explain the topic.	<u>Organization:</u> The writer establishes an organizational plan and consistently maintains it.	<u>Audience:</u> The writer provides scientific information relevant to the needs of the audience.	<u>Language:</u> The writer consistently provides scientific vocabulary and language choices to enhance the text.
<b>Proficient 3</b>	<u>Development:</u> The writer provides scientific facts and concepts that adequately explain the topic with some extension of ideas. The information is usually accurate and purposeful.	<u>Organization:</u> The writer establishes and maintains an organizational plan, but the plan may have some minor flaws.	<u>Audience:</u> The writer provides information most of which is relevant to the needs of the audience.	<u>Language:</u> The writer frequently provides scientific vocabulary and uses language choices to enhance the text.
<b>Emergent 2</b>	<u>Development:</u> The writer provides scientific facts and concepts that inadequately explain the topic. The information is sometimes inaccurate, general, or extraneous.	<u>Organization:</u> The writer generally establishes and maintains an organizational plan.	<u>Audience:</u> The writer provides some information relevant to the needs of the audience.	<u>Language:</u> The writer sometimes provides scientific vocabulary and uses language choices to enhance the text.
<b>Novice 1</b>	<u>Development:</u> The writer provides insufficient scientific facts and concepts to explain the topic. The information provided may be vague or inaccurate.	<u>Organization:</u> The writer either did not establish an organizational plan or, if an organizational plan is established, it is only minimally maintained.	<u>Audience:</u> The writer did not provide information relevant to the needs of the audience.	<u>Language:</u> The writer seldom, if ever, provides scientific vocabulary and uses language choices to enhance the text.

